AAAC Proposal Pressures Study Group

Interim Report Summary

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September 30, 2015

NASA HPS Meeting

Proposal Success Rates Have Fallen

- Success rates for competed research proposals in the Astronomical sciences (Heliophysics, Astronomy & Astrophysics, Planetary Science) have fallen dramatically over the last decade at both NASA and NSF
- What is the cause of the change?
- What are the impacts of the change?
- Are there optimum and catastrophic thresholds for success rate?

AAAC Proposal Pressures Study Group

Established Summer 2014

Gather relevant proposal and demographic data from both the agencies and the community in order to understand how the funding environment over the last 10 years has affected researchers and projects. We will compare funding models across agencies and determine appropriate metrics for evaluating success. This will allow us to provide data-driven projections of the impact of such trends in the future, as well as that of any proposed solutions.

Members

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Agency Contact Persons

NSF/AST: Jim Ulvestad, (Daniel Evans)
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NASA/APD: Paul Hertz, Hashima Hasan, Linda Sparke
DOE/HEP Cosmic Frontier: Kathy Turner
NASA/HPD: Arik Posner
NASA /PSD: Jonathan Rall
AAS: Joel Parriott
NRC (NAC): David Lang, James Lancaster

The **Astronomy and Astrophysics Advisory Committee** – advises NSF, NASA and DoE

Rising Number of Proposals + Budget not keeping up ➔ Declining selection rates
Many areas of scientific research are experiencing this trend

AAAC interacts primarily with NSF/AST, NASA/APD, DOE/HEP Cosmic Frontiers, with increasing overlap with NSF/PHY program in particle astrophysics and gravitational physics, planetary science, and solar and space physics in both NSF & NASA, and the NSF polar program.

NSF Division of Astronomical Sciences: Very extensive database, all proposals traced by reviewer and proposer. Demographic data kept. Queries need to be properly formulated.

NSF Division of Physics: Access to NSF database, but not as extensively mined.

NASA Astrophysics Segregated by competition. (e.g. linking ATP-2012 with anything else has to be done by hand). Some has been done for certain years, but trends are more difficult. Demographic data is not available.

NASA Heliophysics Similar

NASA Planetary Science Similar

DOE High Energy Physics: Hard to connect new comparative review process (2012) to old. Mostly spreadsheet data from the proposal panel organizers.

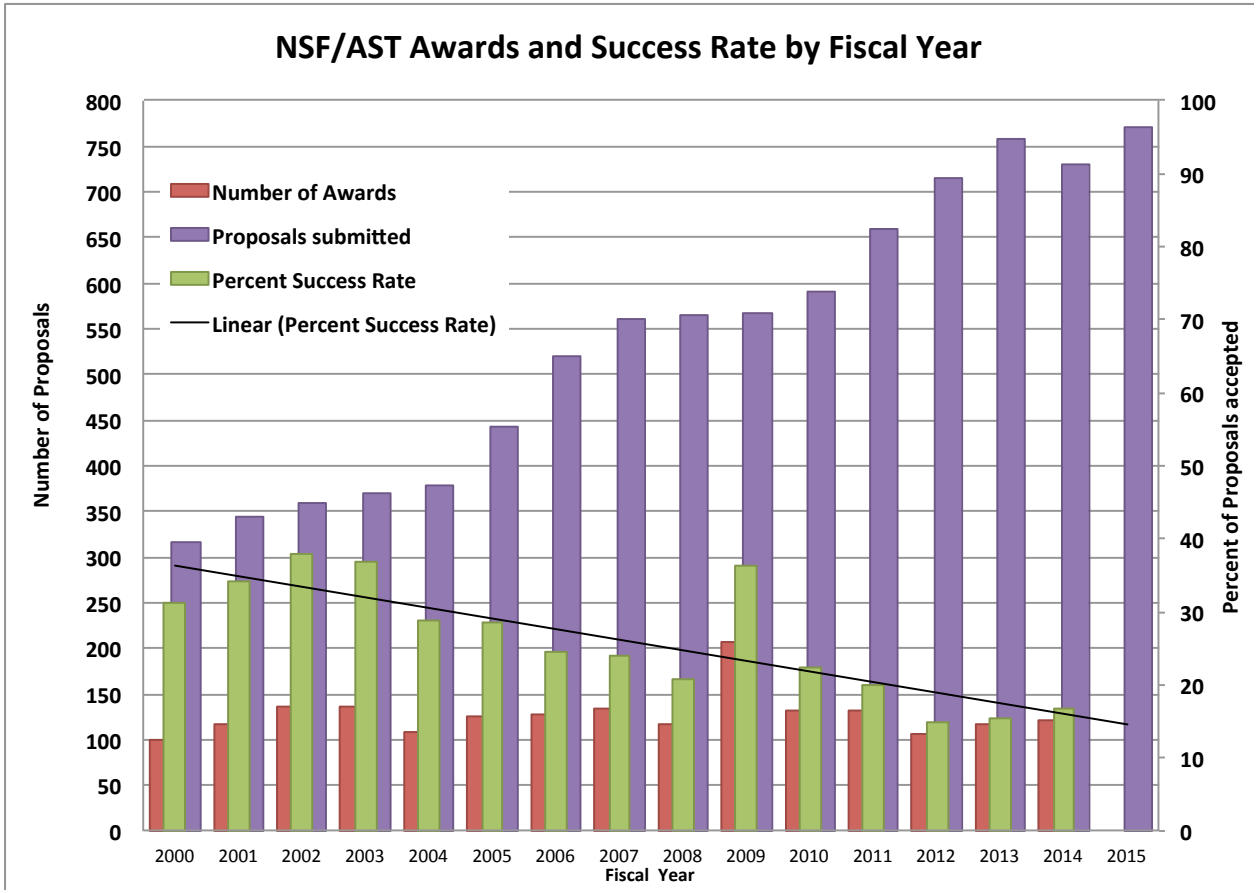


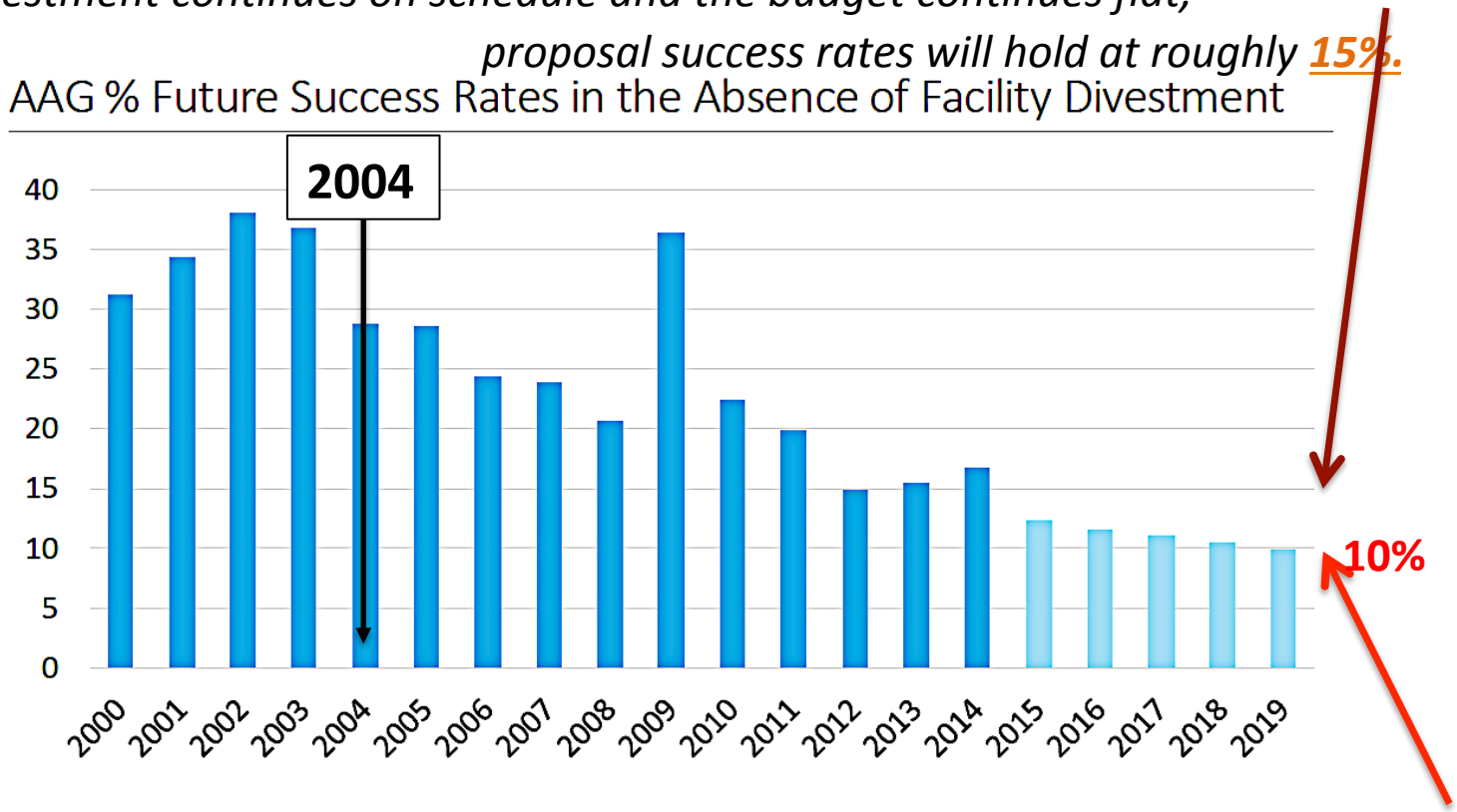
Figure 1. *Historical NSF/AST (AAG) proposal success rate through 2014. The anomalous spike in FY09 is due to the one-time stimulus provided by ARRA the American Recovery and Reinvestment Act.*
http://www.nsf.gov/attachments/131083/public/Dan-Evans_AST_Individual_Investigator_Programs-AAAC_Meeting.pdf

Proposal Pressure in NSF/AST

GB Observing Facilities Divestment Recommended by Portfolio Review Changes the Balance, But Will Not Solve the Problem

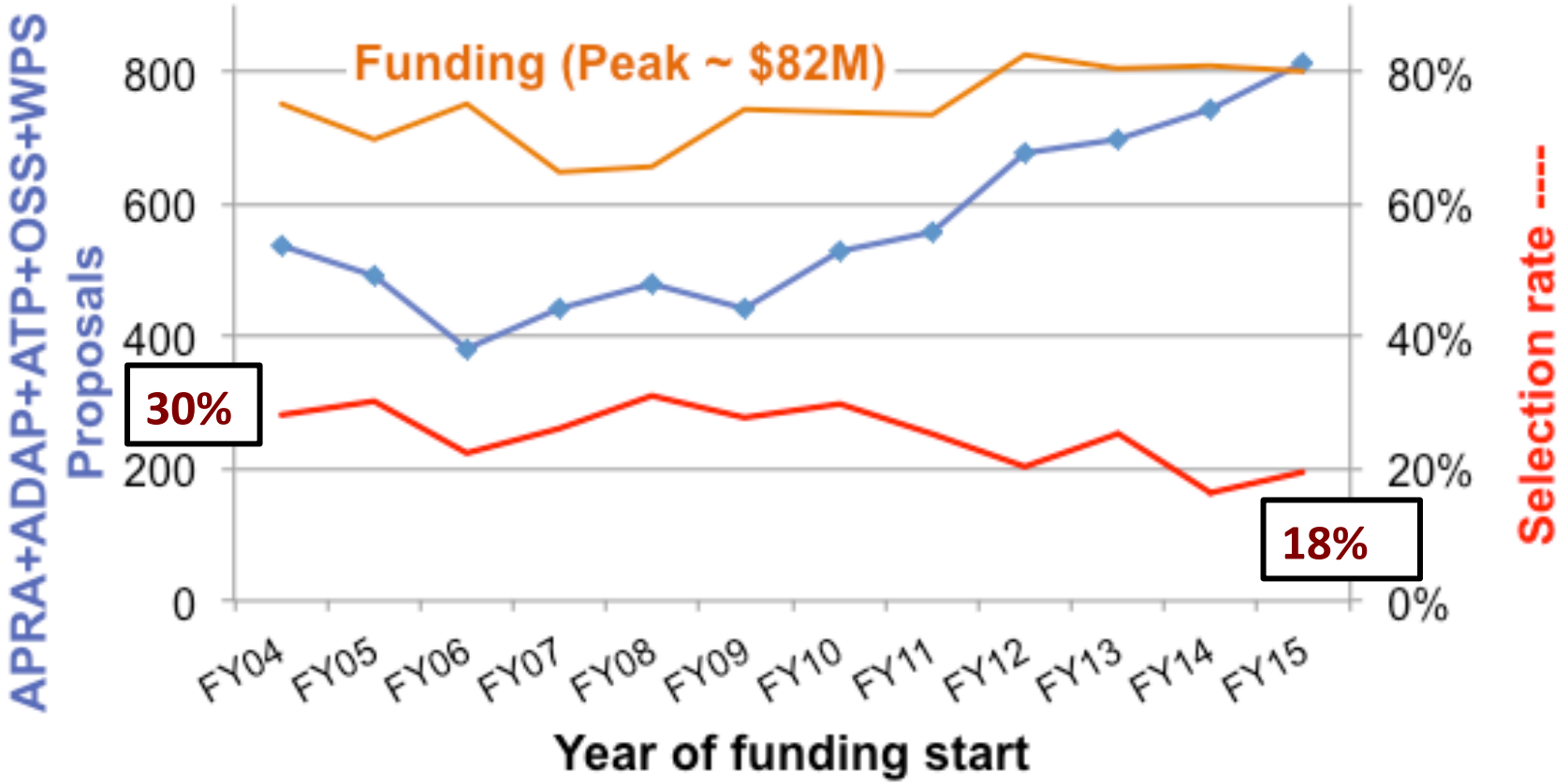
If divestment continues on schedule and the budget continues flat,

*proposal success rates will hold at roughly **15%.***



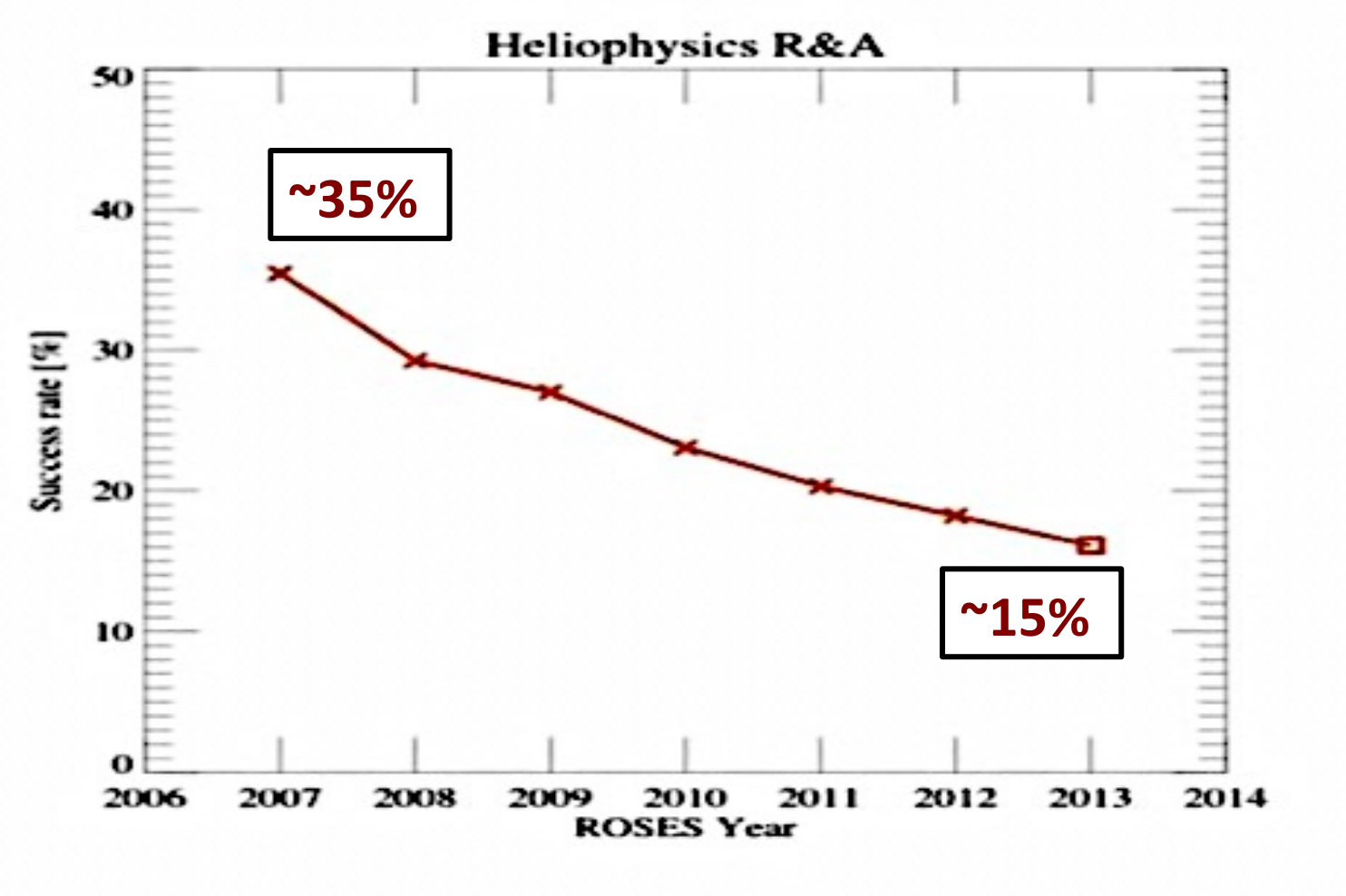
*Projected NSF/AST (AAG) proposal success rate **10%** in the **absence of facility divestment**.*

Proposal Pressure in NASA/ Astrophysics



Proposal Pressure in Heliophysics (NASA)

Overall Selection Rate is falling across NASA/HPD ROSES



Only full proposals, not step-1 proposals

Of Course It Is More Complicated: Breakdown by Program

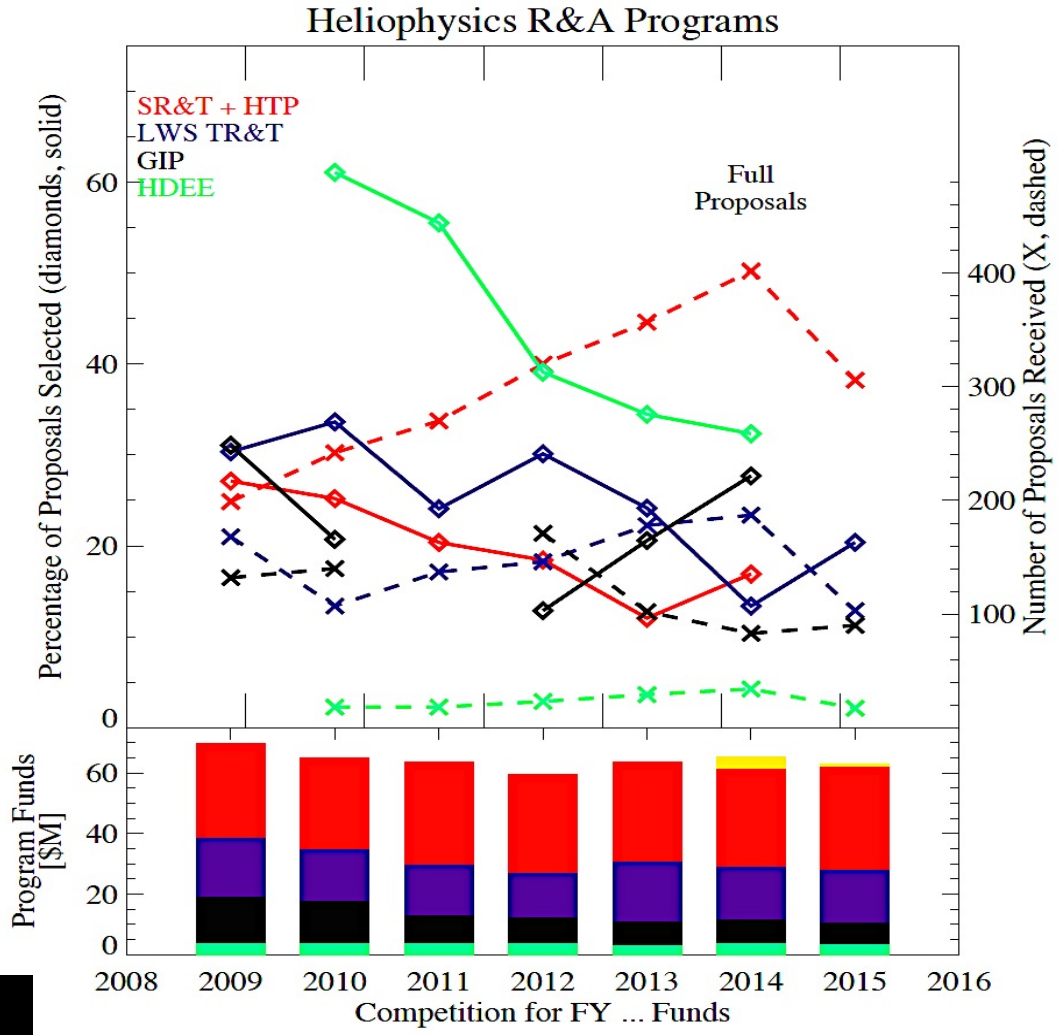
Avg size of annual awards increased

Over 50% of these are “unique PI”
i.e. the only proposal submitted

The more programs open, the higher the multiple proposal submissions

The balance in gender ~83% male
- if identified !

Heliophysics Guest Investigator Program was suspended in FY 2011



Heliophysics Guest Investigator program.

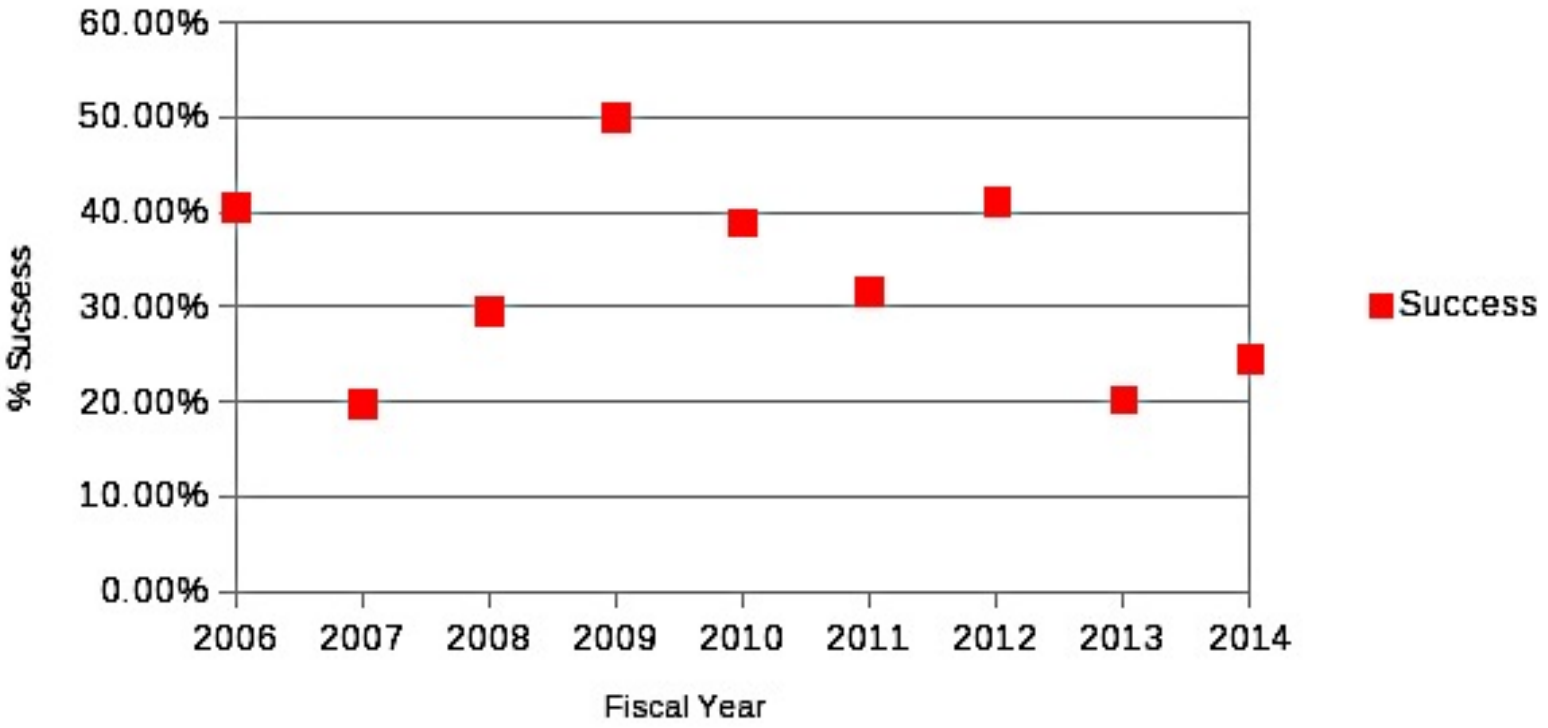
Living With a Star Targeted Research and Technology program.

Heliophysics Supporting Research and Technology program Heliophysics Theory program.

Heliophysics Data Environment Enhancements program.

SR&T Heliophysics Cubesats

Proposal Pressure in NSF Heliophysics



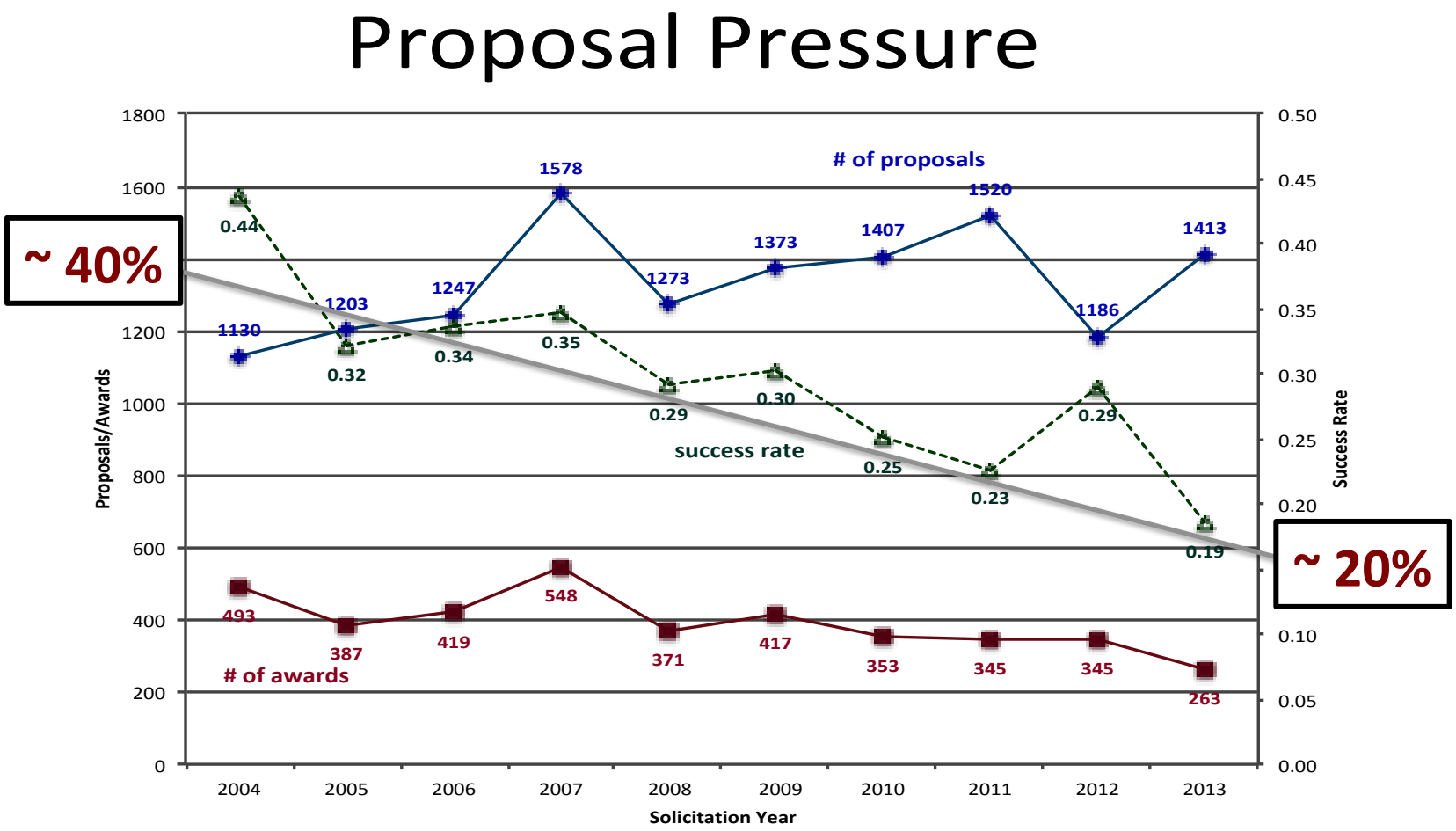
Proposals submitted to NSF/AGS Solar-Terrestrial Research Program

Evolved and grown somewhat since 2009, but highly variable.
The number of awards averaged about 25
Average award size has grown from $90K/yr (2009) to $114K/year (2014)

Proposal Pressure in NASA Planetary Science

Total Division Budget (inflation-adjusted):

$1,731M (2004) ➔ $1,380M (2015)



Proposal Pressure in NSF/PHY - Particle Astrophysics

Astronomy and Astrophysics with Particles (began in 2000)
PA budget has been a steady percentage of the NSF/PHY budget, around 7%

cosmic rays (Auger) cosmic neutrinos (IceCube)
gamma-rays (VERITAS, HAWC) dark matter (Xenon, SuperCDMS)

2005 ➔ 2014 Number of proposals doubled (from 30 to 70)
Funding increased ~34%
Average success rate: **45% (2005-7) ➔ 39% (2012-2014)**

FY	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
NSF ($M)	5481	5646	5884	6084	8870	7572	6913	7105	6902	7172
PHY ($M)					358		281	280	253	266
PHY-PA ($M)	14.7	15.9	16.1	15.8	31.2	17.9	19.2	17.7	18.8	19.7
#grants (incl suppl and CGIs)			84	83	104	110	96	144	127	133
#PIs			74	75	101	134	126	122	121	114
Success Rate (%)	27	57	51	46	73	71	52	54	31	33
Grants vs Facility: IceCube M&O ($M)							3.45	3.45	3.45	3.45

DOE: High Energy Physics at the Cosmic Frontier

Success rates much higher. Proposal Acceptance going up
but may decline to ~ 50% in FY15

Different Mode: Mostly block grants with multiple PIs.
Stable number of Universities, applying every 3 yrs, staggered by years
$$ awarded depends on who is up for renewal
Comparative review process began in 2012
Energy, Intensity, Cosmic separately reviewed

DOE CF university research grants in $K	FY12	FY13	FY14
CF Univ grants - total $	12861	12222	13157
CF Univ grants - $ funded for new CR grants this FY	1605	3410	4270
CF Univ grants - $ requested for new CR grants this FY	3487	7700	7500

DOE CF # new grants	FY12	FY13	FY14
#CF Univ grant CR proposals funded	10	28	28
#CF Univ grant CR proposals reviewed	6	18	19
#CF Univ grant CR proposals success rate	60%	64%	68%

Summary of Proposal Pressure

- The proposal selection rate for NSF Astronomical Sciences and NASA Astrophysics has been halved, from approximately 30% to 15% in the last decade.

- Similar trends observed in NASA Heliophysics and Planetary Science Divisions

- Trends can be seen overall, but details in individual programs are complicated
  - Programmatic changes or cancellations/suspensions
  - Fewer statistics
  - Changes in the size of awards

- NSF Particle Astrophysics and Heliophysics programs are highly variable
  - Again, program size makes statistics difficult
  - Trend is downward

- DOE High Energy Physics Program has a different funding model
  - Success rate has stayed stable above 50% in Cosmic Frontier
  - Only 3 years of comparative review panel data available

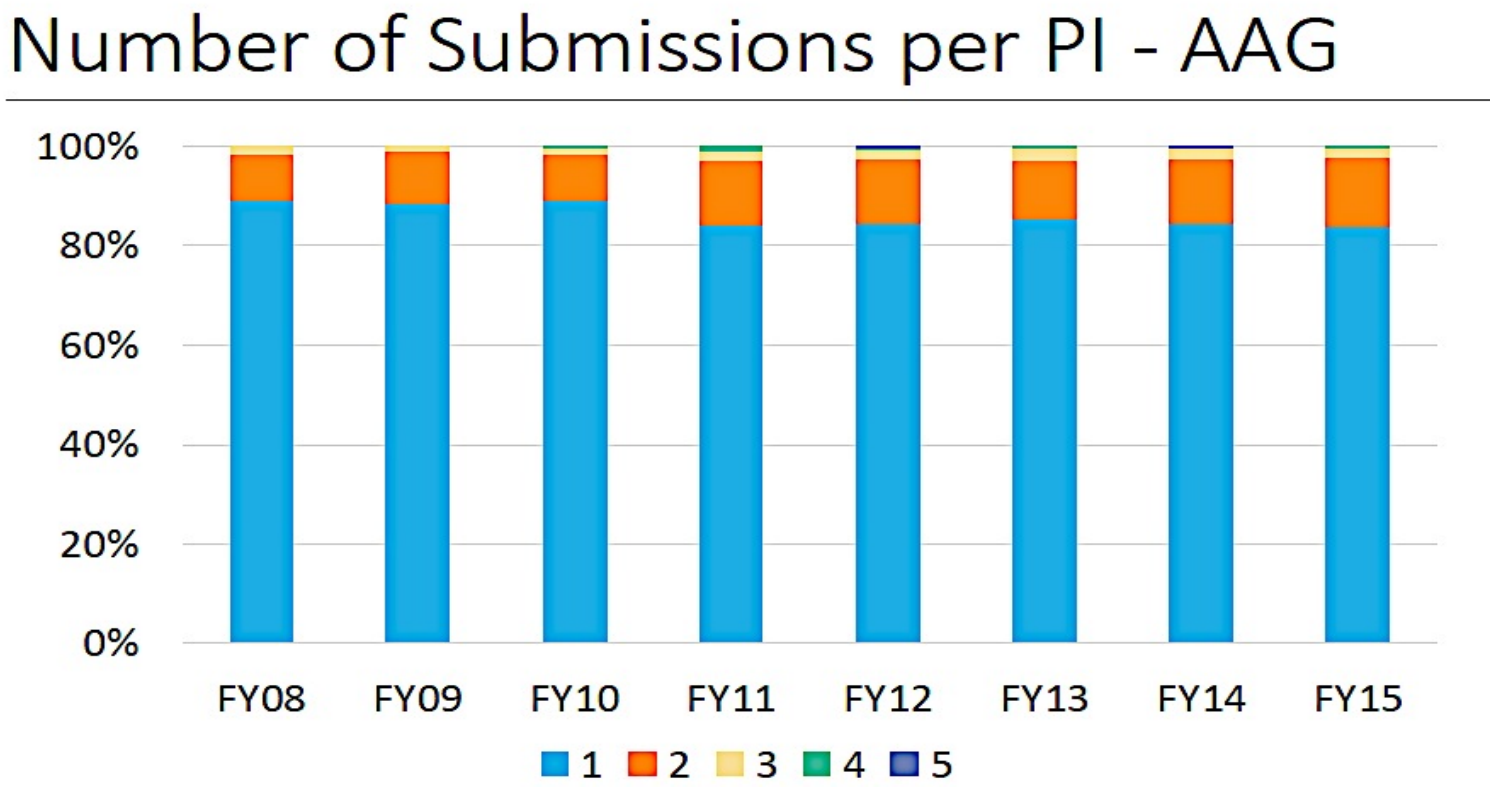
Next, drill down to understand demographics

What are some of the causes for the change in proposal success rates?

- Changes in PI submission rate?
- Changes in number of PIs?
- Changes in PI demographics (age, institutions)?
- Changes in Quality of proposals?
- Proposal recycling?
- Changes in the size of proposed budgets?
- Changes (or lack thereof) in Agency budgets?

Most NSF/AST and NASA/APD Proposals are Single Proposals

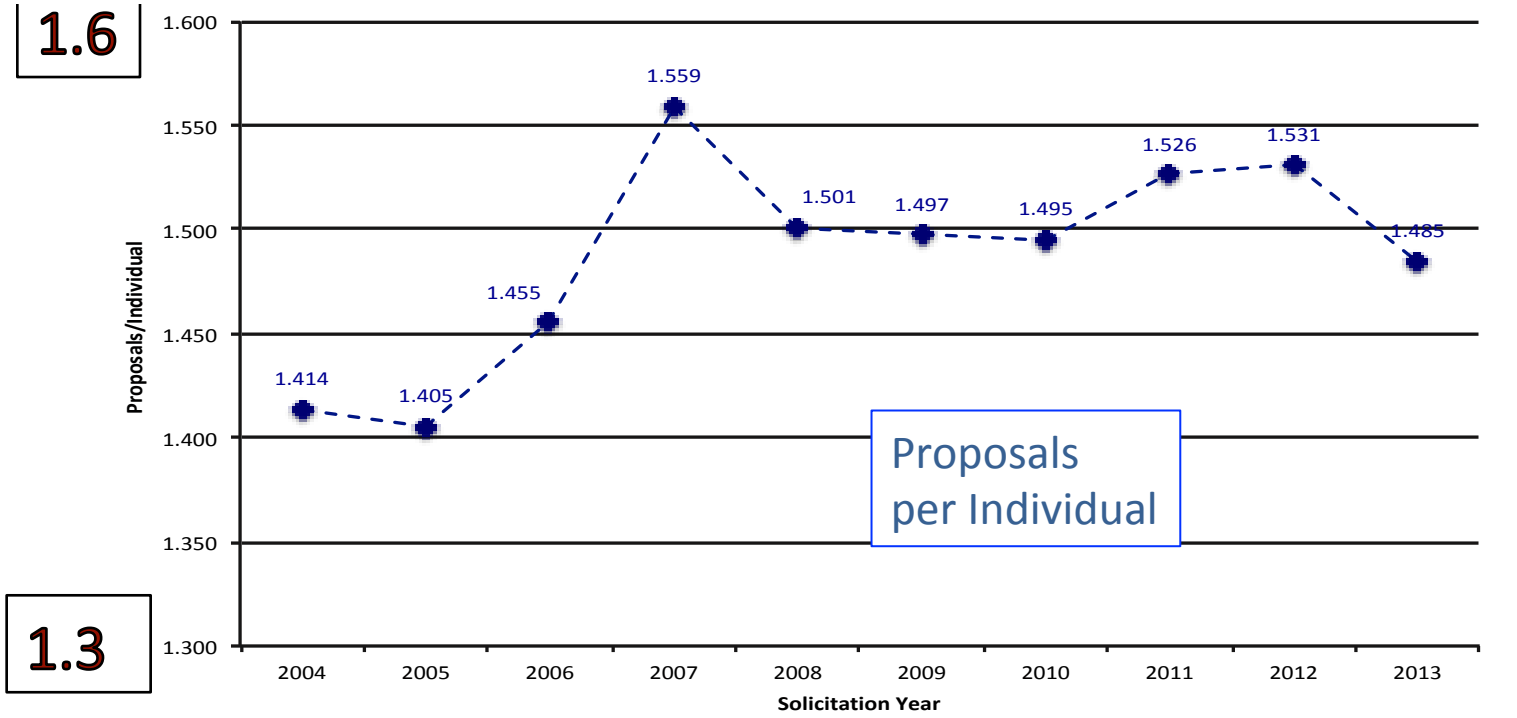
Proposal Increase → The Actual Number of Unique PIs is rising



NSF Astronomy Only ~ 15% Multiple Proposals

Multiple Proposals in NSF Planetary Sciences

NASA/PSD funding is distributed over 34 programs
Multiple proposals rose from 40% to 60% starting around 2005



Recently began using two-step process, where
First Step = Direct proposals to the proper program
and look for largely identical proposals submitted more than once

Fraction of Proposals by age of PI (NSF/AST)

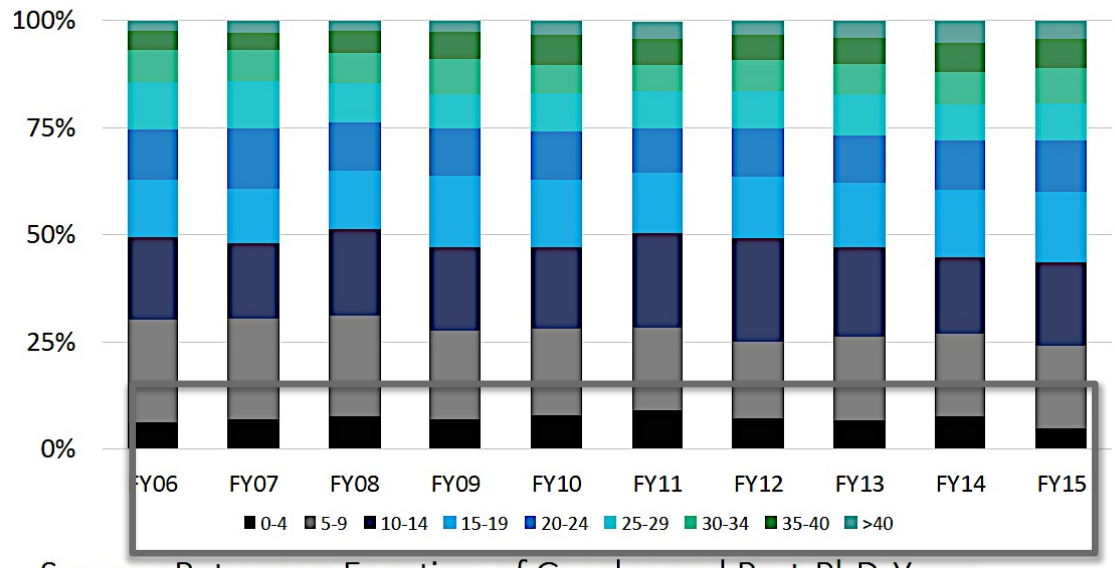
No "Postdoc Problem"

The suggestion that recent generous postdoc fellowship programs and targeted encouragement have boosted one segment of the population that is now moving through the system as an increased PI pool

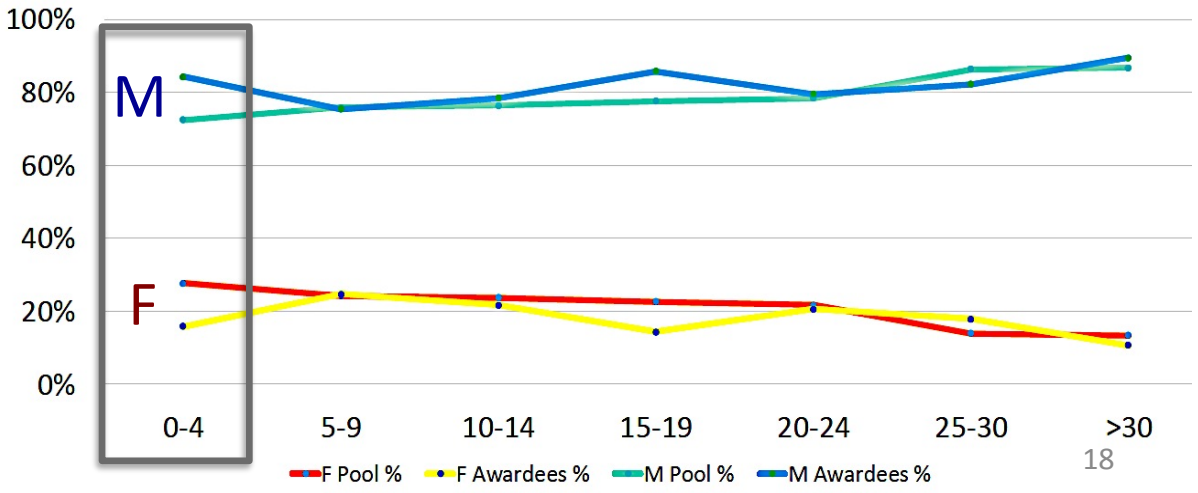
… is NOT true.

Result doesn't depend on gender. Slight increase in women in the younger pool is encouraging.

Years Post-PhD of AAG Principal Investigators



Success Rates as a Function of Gender and Post-PhD Years – AAG FY11-14



Fraction of Proposals by age of PI

NSF/PHY Particle Astrophysics is slightly different

	Prof	Assoc Prof	Assist Prof	Research Personnel	Female	Male	Number of proposals with at least one Co-PI	Total proposals
FY2008	31	7	5	2	5 (11%)	40	24	45
FY2014	35	12	18	5	17 (24%)	53	23	70

	>24 yrs	20-24	16-20	12-16	8-12	4-8	0-4 years	Total
FY2008	<1984	'84-'88	'88-'92	'92-'96	'96-2000	2000-2004	2004-2008	
	21	4	8	5	4	2	1	45
FY2014	<1990	'90-'94	'94-'98	'98-2002	2002-2006	2006-1010	2010-2014	
	27	10	5	9	10	8	1	70

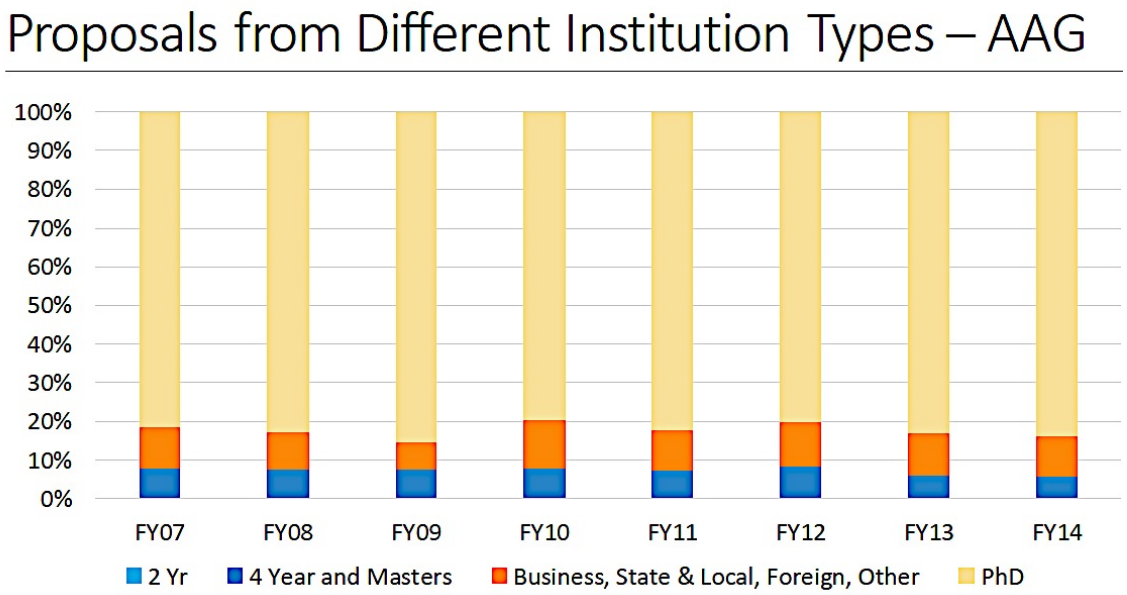
Fraction of female PIs is rising: 11% (2008) ➔ 24% (2014).
Fraction of younger PIs is rising: 10% (2008) ➔ 27% (2014)
defined as <12 years from PhD.

Low statistics

BUT 2008 NSF/PHY PA proposers is heavily weighted toward senior PIs.
2014 NSF/PHY PA age fraction now matches the more stable NSF/AST distribution.

Institutional Affiliation (NSF/AST and NASA)

Suggestion:
More proposers from smaller non-traditional institutions?
NOT true.



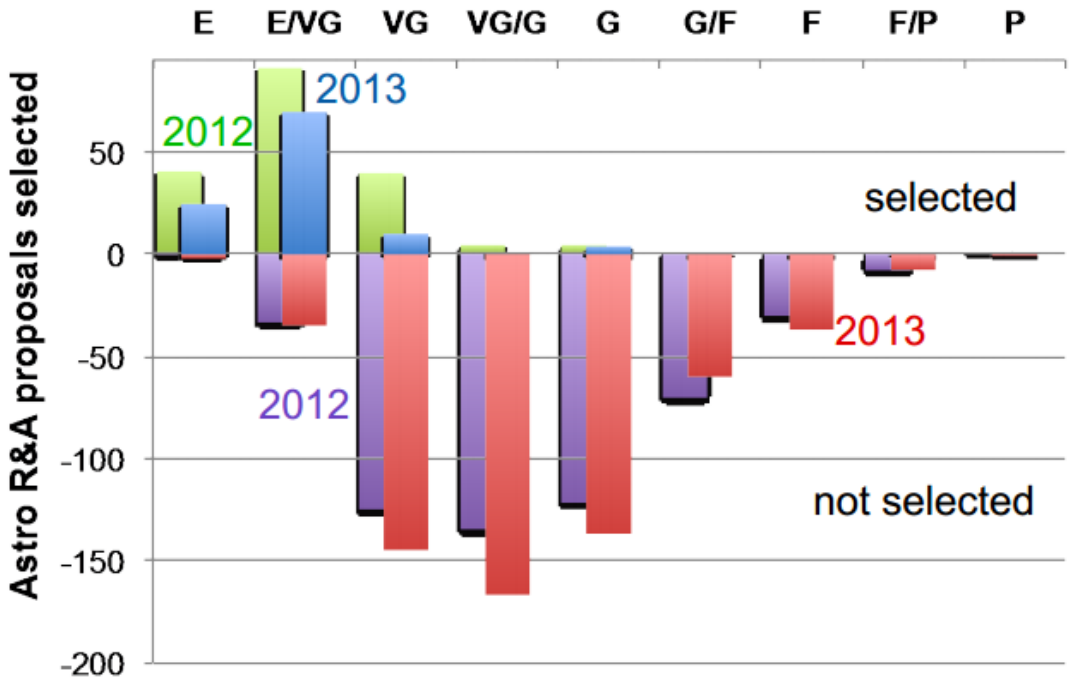
Year	Very High Research Activity Universities (107 in the US)				Other Universities		Research Institutes			
	Public		Private				NASA operated or funded**		Other***	
	# Grants	# Unique Institutions	# Grants	# Unique Institutions	# Grants	# Unique Institutions	# Grants	# Unique Institutions	# Grants	# Unique Institutions
2010	53	27	24	10	14	10	18	4	14	9
2011	46	26	23	13	14	12	15	5	30	15
2012	48	21	26	15	10	10	22	5	20	11
2013*	22	15	15	9	9	6	5	2	13	7

*Does not include APRA, which was carried over to 2014
** Includes NASA field centers plus JPL and STScI
*** Includes, e.g., SAO, Carnegie, SwRI, LBNL

Is the number of Excellent Proposals funded going down?

Quantifying this takes a figure of merit

Reviewer rating is not a good merit indicator for NSF or DOE/HEP Cosmic Frontier
NASA reviewer ratings are more reliable,
but anecdotal evidence for NSF and DOE is in line with data from NASA



2012 ➔ 2013
Fraction of proposals rated ≥ VG
46.7% ➔ 41.9% (-10%)
Decrease in success rate ≥ VG
51% ➔ 39% (-24%)

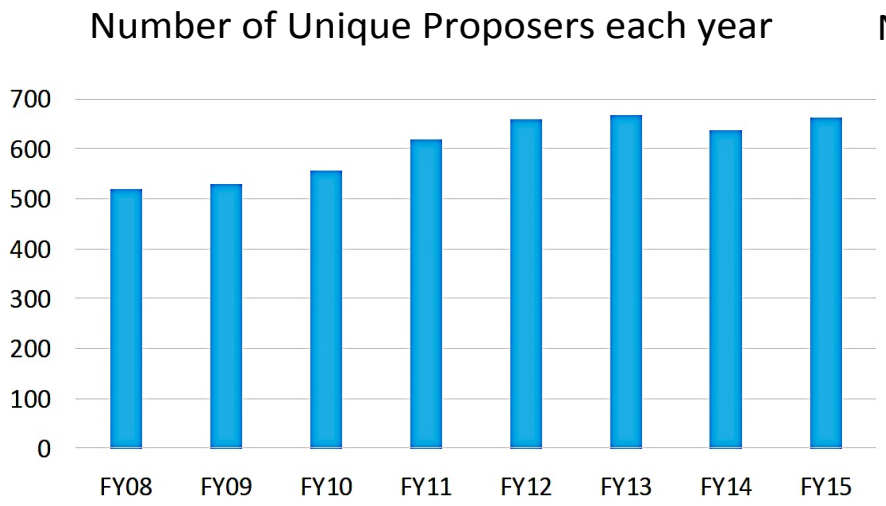
All SMD ROSES: Number of funded proposals in the VG category was 45% in 2007-2008
Funded from Plot : 25% VG (2012) ➔ 7% (2013)

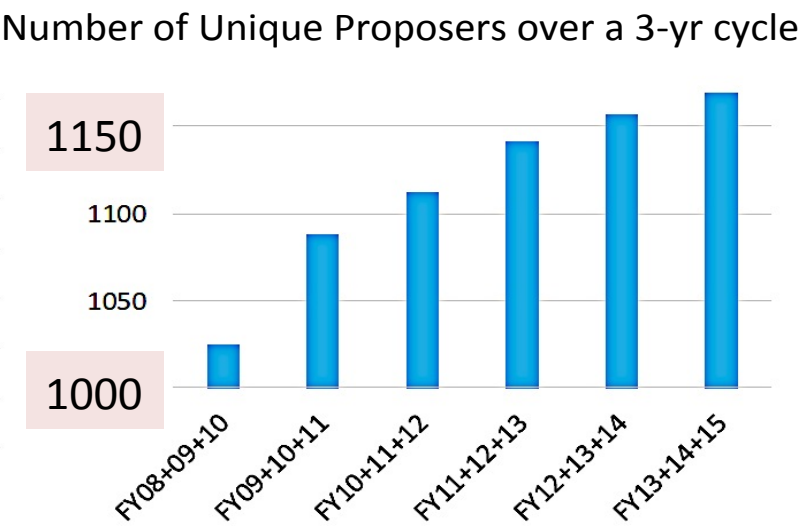
The Loss is in the VG category, while VG/E and E remain stable at >75% and >90% respectively

http://science.nasa.gov/media/medialibrary/2014/04/09/2014.03.27_ApS_RA_final-2.pdf

Is Selection Rate being driven by Repeat Proposals?

Number of unique PI per year > 1/3 of unique PI over 3 yr





Unsuccessful proposals are being resubmitted.

Modeling the data:

- Suppose the number of non-repeat proposals remains steady.
- Successful ones removed from pool, unsuccessful ones reapply next year
- Apply the actual success rates each year to the mix of new and repeat proposals.
- A best fit ➔ 70% of the unsuccessful proposals reapply in the following year.
- If repeats at at 50% in 2008, by 2014 repeats will be at 60%

Proposal spiral: Ever more unique Pis reapply in consecutive years, accelerating the rise in proposal numbers and falling selection rate

Summary of Demographics
Only collected for NSF and NASA

- The number of proposers is going up, not just the number of proposals.
  Multiple proposals from the same PI is monthly not a driver

- The rise in the number of proposers is not coming disproportionately
  from new assistant professors or research scientists
  or from non-traditional institutions

- They do not represent a shift in gender or race

- The merit category that is being depleted has a rating of VG
  Very Good proposals are not being funded

- Initially unsuccessful proposals are being resubmitted at a higher rate

- Proposal budgets are not growing as fact as inflation

- Agency budgets generally have been flat, though not in APD.

What are some of the impacts of more proposals and declining success rates?

Impact on Agencies (NSF/AST)

Managing review panels.

NSF/AST staff FTEs have remained relatively flat

But they are running more panels

Each panel has a higher number of proposals.

Organization and execution of each panel takes 130+ hours (NSF Program Officer)

"NSF has developed new tools to optimize internal review processes, but another 30% increase in proposal volume over the next five years would not be sustainable."

Recruitment of reviewers and Conflict of Interest

An individual listed as PI or co-PI on an NSF/AST AAG proposal cannot serve as a reviewer.

- 1,100 qualified individuals are prohibited from joining a panel.
- Hard to find un-conflicted senior members of the community to join the panels.
- Declining reviewer acceptance rates; 20-25% of reviewers agree to serve
- Drives up the time program staff spend on appointing panelists.

Impact on Agencies (NASA/APD)

(statistics courtesy of H. Hasan)

COST (2014)

832 proposals handled in core R&A programs.
Estimated cost: ~ $ 3M

NASA staff time, direct expenses for reviewer travel, meeting space, plan, execute, and document the evaluation and selection process

Basis of estimate clearly delineated in spreadsheet.

this cost does not include the cost of the GO program TAC reviews that handle three times as many proposals

FINDING REVIEWERS

Statistics currently: 50% of prospective reviewers accept when asked 4-6 mo.
20% when asked 3-4 weeks ahead

Will this change in the future?

CONFLICTS OF INTEREST

Currently not a problem.

COI issues can often be mitigated by putting the reviewer on a different panel from the problematic proposal

Is there a proposal success-rate floor?

A healthy level of competition identifies the best science and boosts productivity.

Unhealthy success rates discourage innovation and cause inefficiencies.

- Probability of success / failure
- Cost to scientific productivity
- Cost of review process
- Impact on health of discipline
- Impact on U.S. competiveness

Cumulative Probability of Proposer Failure vs. Success Rate

PROPOSAL SUCCESS RATE	P (no funding) 1 try	P (no funding) 2 tries	P (no funding) 3 tries	P (no funding) 4 tries	P (no funding) 5 tries
10%	90%	81%	73%	66%	59%
15%	85%	72%	61%	52%	44%
20%	80%	64%	51%	41%	33%
25%	75%	56%	42%	32%	24%
30%	70%	49%	34%	24%	17%
35%	65%	42%	27%	18%	12%

Table 1. *Probabilities of unfunded proposals for different hypothetical funding rates and number of proposal attempts. The green shaded cell represents the state of the field circa 2003 (see Fig. 1). The red shaded cell represents the impending situation expected by FY2018 in the absence of portfolio rebalancing. The yellow shaded cell is the nominal "absolute minimum" benchmark identified here as the point at which new researchers spend more time proposing than publishing papers; it is not a sustainable benchmark and should be regarded as a temporary acceptable minimum.*

The Matthew Effect - New/unfunded researchers suffer decreased success rates – as much as 8% lower than currently funded proposers.

Von Hippel and Von Hippel, 2015: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118494

The Opportunity Cost of Writing Proposals

Writing a proposal takes time. Von Hippel & Von Hippel survey results suggest that it takes a PI 116 hours and CoIs 55 hours to write a proposal. That translates into a number something like 0.4 papers.

With success rates at 20%, that means the time cost of writing a successful proposal is greater than the time it takes to write 2 papers.

The typical astronomy grant results in about 8 publications. As success rates fall even further, new researchers with success rates at 6% will spend more time writing proposals than would be spent writing the papers that result from a successful proposal.

Summary & Remarks

- **Increase in the number of PIs and in many programs long no-growth budget profiles have led to decreasing proposal success rates.**
- **The cause does not lie in changing demographics, proposal quality, grant size.**
- **The tendency to recycle proposals exacerbates the problem.**
- **Lower success rates stress the agencies, reviewers, the community, and the nation.**
- **Success rates greater than 30% are healthy.**
- **Success rates of 15% are not sustainable – anecdotally people are leaving, panels are more risk averse, and new researchers are not entering the field.**

The solutions are not clear.
Options include:

- More funding
- Rebalancing the program
- Fiddling with the process – grant size, grant opportunities
- Decreasing the size of the U.S. astronomical science community – strategically or not

FUTURE PLANS

- Possibly administering a survey to AAS, APS members
- Continuing to refine data from Agencies
- Publishing a Final Report by the end of 2015 or early 2016

Our hope is to have data-driven answers

Not on what the agencies SHOULD do,

but what are the likely results of Actions like

➡ Do nothing

➡ RFP every other year

➡ Limit number of proposals per PI

➡ Limit funding available per proposal

➡ Initiate pre-proposals or sifting method

Other… ?

Back up Slides

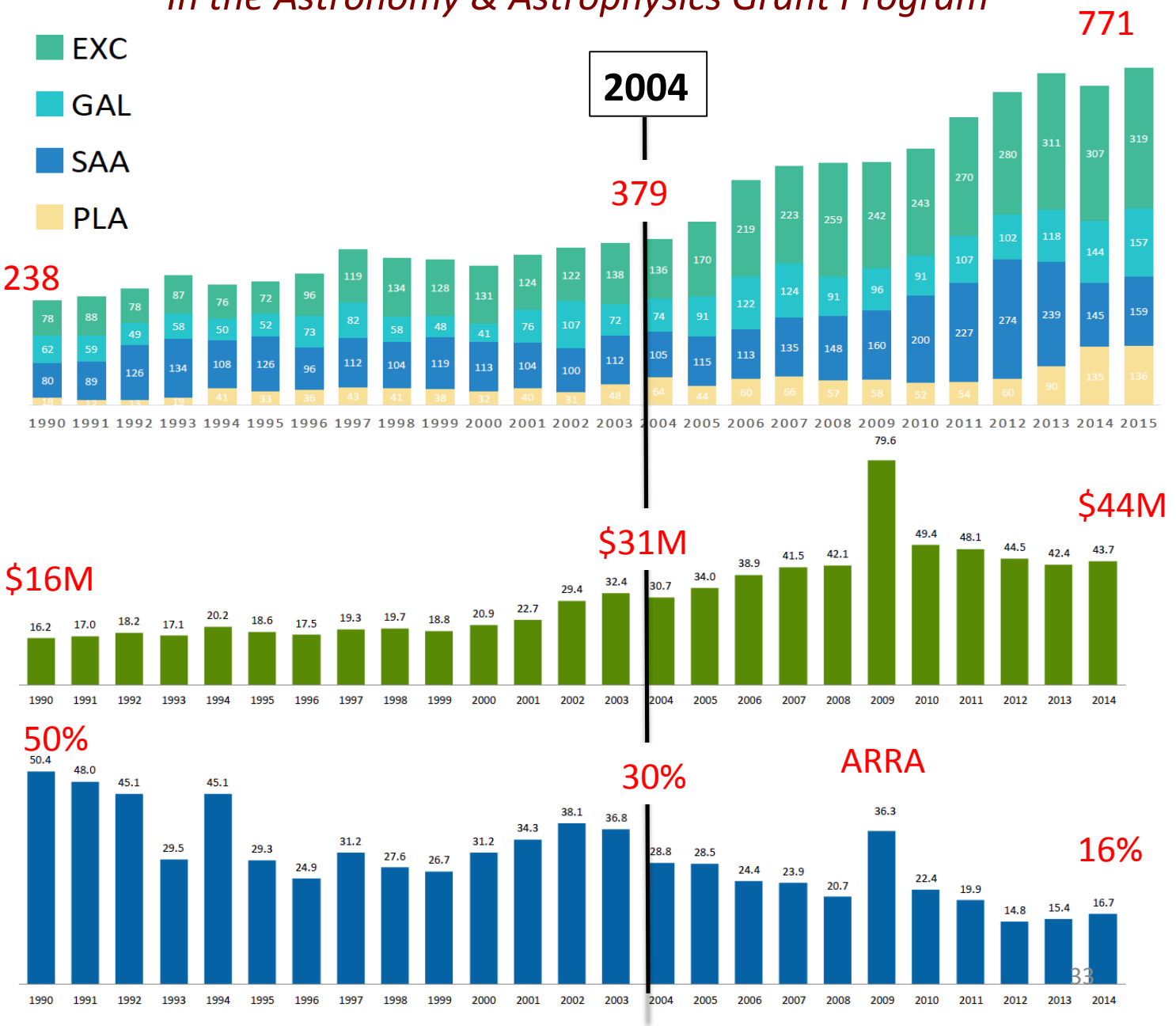
Proposal Pressure in NSF/AST

In the Astronomy & Astrophysics Grant Program

Number of AAG Proposals by program and year

AAG Budget $M

AAG Proposal Success Rate



Impact on Researchers

Requires a Survey

Draft a set of questions in conjunction with AAS (Todd Hoeksema, James Lowenthal)
Put in a Proposal to AAS for preparing a Survey
If accepted, AAS provides funding to AIP to
professionally develop and manage and administer survey

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II. Career Info
=========

What is your current employment status?
(grad student, postdoc, research staff, tenure-track faculty, tenured faculty)

At what kind of institution are you employed?
   -- Research university with graduate department
   -- Primarily undergraduate institution
   -- Private observatory
   -- NASA center
   -- National observatory
   -- Industry (aerospace; optics; detector technology...)

More demographic info:
     -- How long since PhD?
     -- Looking for permanent job?
     -- If postdoc, how many previous postdoc positions?
```

Etc…

Impact on Researchers

Requires a Survey

Is any of your regular salary currently from PI grant support? Do not include academic summer salary.

If yes,
-- What is the funding agency or agencies?
-- What percent of your salary comes from those grants?
-- Were you a PI, a Co-I, or neither (for each grant)?

If your salary is a 9-month academic salary, do you currently (or within last xx years?) have grant support for summer salary?

If yes,
-- what is the funding agency or agencies?
-- what percent of your summer salary comes from those grants?
-- Were you a PI, a Co-I, or neither (for each grant)?

III. Grant application history:
==========

On how many grant applications to each of the following have you served as PI during the last 5 years? How may were approved?
[Include formula-driven grants such as HST, Spitzer...?]

Agency	Requests	Approved
NSF AST		
NASA [div/branch?]		
DOE		

Etc...

Impact on Researchers

Requires a Survey

A series of multiple choice statements with 5 choices.

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IV. Effect of grant proposal success rate on your career
==================================

I feel that my career has been negatively impacted by low proposal success rates
at NSF, NASA, and/or DOE:
(strongly agree <--> neutral <--> strongly disagree)

I am seriously considering leaving astronomy because of low proposal success
rates:
(strongly agree <--> neutral <--> strongly disagree)

NSF AST, NASA, and DOE are all considering or have begun limiting applicants to
2 or fewer PI or CoI proposals per year.  I believe such limits are a good
solution for addressing low success rates.
(strongly agree <--> neutral <--> strongly disagree)
```

Etc…